UNITED STATES COAST GUARD

ADDRESS REPLY TO:
COMMANDING OFFICER
FIELD TESTING & DEVELOPMENT UNIT
U. S. COAST GUARD YARD
CURTIS BAY 26, MD.

CGTD F3-1/1(a)
FILE: 18 DEC 1958

AD-208 126

From: Commanding Officer, Field Testing & Development Unit
To: Commandant (ETD)

Subj: Prototype Helicopter Towing Equipment

1. Certain tests as indicated below were made by FTDU personnel under the supervision of ATCS Edward J. Cousins on 2 and 9 December 1958 at the Field Testing and Development Unit. The tests were undertaken by authority of Commandant (ETD) letter 1 December 1958, file CGTD F3-1/1(a) to Commanding Officer, Field Testing and Development Unit.

2. The tests were undertaken to prove the prototype equipment for measuring towing forces exerted by a helicopter against the specifications prior to operational evaluation. The equipment was tested against the following Commandant (EAE) (no date) specification paragraphs, indicated in parenthesis below:

2.1 (3.4) RELEASE

2.1.1 (3.4.1) Normal Release. The normal release is intended to drop the tow cable after each towing mission is terminated. (It is not desired to retrieve the cable into the helicopter, nor to return and land with the cable dangling). The release should be operated from the pilot's cyclical pitch control stick. It should be positive in action, capable of actuation under full load, and incapable of inadvertent release.

2.1.2 (3.4.2) Emergency Release. The emergency release should not depend upon the electrical system of the aircraft. The release should be positive in action, capable of normal actuation under full load, incapable of inadvertent release and operable from the helicopter cabin.

NB: If frangible means are used for release there must be no evidence of possible damage to the aircraft by reason of shrapnel, or other effects.

2.1.3 (3.4.3) Automatic Release. The automatic release, if expendable should be readily replaceable and of inexpensive design. The strength of the device shall be compatible with the class of the unit. They should part at the class maximum load plus 10% minus zero. Use of several Class I devices in parallel for heavier loads is acceptable, if loads can be shown to be evenly distributed under all circumstances.

2.2 (3.5) Gage and Indicator. The gage and indicator shall indicate to the pilot the tension in the cable, to plus or minus 5%, at all times that a tow load is applied.

2.3 (3.6) Weight. Weight of all components shall be held to a minimum.

2.4 (3.7) Materials. Materials shall be corrosion resistant, or adequately treated for corrosion resistance. The units will normally operate in an ocean atmosphere, and the droppable parts may be immersed in sea water.

2.5 (3.8) Radio Interference. If electrical components are used, radio interference should be adequately suppressed.

3. Material under test.

3.1 Name - Helicopter 'TUGBIRD' towing link, prototype.
Manufacturer - Bytrex Corporation, Newton 58, Mass.
Drawing No. - B-10033
Capacity (rated - 4000 lbs. (tension).

3.2 The components of the equipment include:

3.2.1 Control unit, Model 30133.

3.2.2 Junction Box, Model 30128.

3.2.3 Indicating meter, % maximum tow load, Lewis Engineering Company Part No. 1528MA2, Scale: 0-20-40-60-80-100-Red Sector/Line.

3.2.4 Tension link.

3.2.5 Cable assembly.

3.3 Auxiliary test equipment.

3.3.1 Three ton capacity chain fall. Make - Yale, Model BB, Purchase Order No. CG72-287.

3.3.2 Dynamometer, 0-15000 lb scale. Make - Dillon, Serial No. AN20396, Scale increment - 125 lbs.

3.3.3 24 volt direct current power supply. Two (2) each, 12 volt batteries in series.

3.3.4 24"X24"X24" box of 3/4" thick 7-ply plywood, exterior, marine grade, glued and screwed construction, unpainted. One side panel slotted to accept firing and suspension cables.

3.3.5 1/4" wire rope. Ten (10) feet of 6X37 clear plastic coated steel wire rope, with 2" eyes clipped into each end. 3/8" wire clips used to form eyes. Two each of the clips were used to form the 2" diameter eyes at each end of the cable. Advertised wire breaking strength is from 4500 to 5000 pounds.

4. TESTS.

4.1 The release tests were performed by placing the device both free of applied tension and suspended between a crane hook and a measured (dynamometer) applied load.

4.2 The indicating meter was checked in suitable steps by suspending the tension link between a crane hook and a measured load and reading the meter which was actuated by the link.

4.3 The weights of the various parts of the device were measured on a balance to one (1) ounce accuracy.

4.4 The materials were inspected visually to determine their composition and corrosion resistance.

4.5 Radio interference tests were not made since no helicopter type electronic equipment or electrical configuration was available for activation and radio interference measurement in the presence of the device under test.

5. TEST RESULTS.

5.1 Release:

5.1.1 Normal Release. With no cable attached to the device, manual release by actuation of the device was positive. It was also released remotely by a small diameter manila line with a straight pull in a vertical direction under these conditions.

5.1.2 With the cable attached, but with no strain applied, actuation of the release was effective both manually and by the emergency electrical method (i.e., with no power connected from an external source).

5.1.3 With the cable attached and the device tensed under a load of 4000 pounds, actuation of the release was effected manually, by a 24 volt external source, and by the emergency electrical method.

5.1.4 Inadvertent or accidental release of the attached cable is not considered possible unless a planned effort is made to push the recessed switch button. Using a guard over a positive action switch would improve the safety of the action.

5.1.5 The firing of the frangible powder-actuated bolt fractured the bolt. Evidence of shrapnel impact on the inside of the 24" plywood cube, within which the bolt was tested (fractured), appeared at many penetration points about 1/8" deep on all sides of the cube. Five appeared vertically over the stud, that location where the helicopter would occupy when the device is in use. Whether these indentations resulted from shrapnel which ricocheted from the other sides of the box or not was not determinable. Figure 1 (attached) illustrates the shrapnel impact points of two firings without the protecting tube fitted over the frangible bolt.

5.1.6 With the cable attached, the weak-link did not break at 5000 pound applied tension. The cable broke at this load during the 2 December test. During the 9 December test the weak link did not break under 4000 pounds load but the clips became loosened and the cable eye opened. In each case the weak link pin was deformed considerably in the direction of strain at the notched sections.

5.1.7 The percent tow load indicating meter was subjected to the following loads with the corresponding readings resulting. No correcting calibration was made to the meter since it came within the 5% tolerance allowed by the specification except for the maximum (over) loadings.

Calibration Dynamometer (Tension - pounds)	Indicating Meter Readings (% of load)	(% Variance from load)
1000 Pounds	24%	-1 %
1500 "	34%	-3.75 %
2000 "	48%	-2 %
2500 "	58%	-4.5 %
3000 "	73%	-2 %
3500 "	85%	-2.5 %
3700 "	90%	-2.5 %
3900 "	94%	-3.5 %
4200 "	98%	-7.0 %
4300 "	100%	-7.5 %
4600 "	Red Line indication	
5000 "	Cable parted	

5.1.8 Weight components.

Unit	Weight
Control Unit, Model 30133	3 lbs 2 oz
Junction Box Model 30126	2 lbs 5 oz
Indicating Meter	15 oz
Tension Link	1 lb 8 oz
Cable, electric complete	3 lbs 14oz
Total weight	11 lbs 12oz

5.1.9 All materials appear to be corrosion resistant. The tension link housing and manual linkage appear to be made of polished, plated aluminum. The O-Ring seals appear adequate. The frangible stud appear to be cadmium plated steel. The jamb nuts have the appearance and feel of stainless steel. Because of the priority of the test the parts were not subjected to salt/ultraviolet arc accelerated weathering. No method of testing for composition is available at the unit.

6. Discussion of Results.

6.1 The device will release the cable by manual, mechanical means under conditions of no tension and 4000 pounds tension. It will release the cable by internal and external electrical power powder actuated frangible bolt means under conditions of no tension and 4000 pounds tension. These releases were tried once for each condition. Whether the device will operate after having been subjected to more than the one test is not known. Nothing in the construction of the device gave any indication that it won't operate repeatedly in the manner for which it was designed.

6.2 The dynamometer used did not read the actual stress applied. The readings were converted to true stress using the calibration table for the instrument.

7. Conclusions and Recommendations.

7.1 Conclusions

~~7.1.1~~ The device meets the specification in all respects tested except for the notched weak-link pin in the down-stream clevis of the tension link assembly. This pin deformed but did not fracture to release the cable when subjected to up to 5000 pounds of tension.

~~7.1.2~~ The frangible bolt fractured into pieces which could conceivably damage the TUG-BIRD. How much damage to which parts is not known. Fitting of a sleeve (tube) over the frangible bolt is recommended for containing any fragments. Whether each frangible bolt will fragmentate on firing is not known. ~~See paragraph 7.2.1 below.~~

7.2 Recommendations

7.2.1 A loose fitting metal collar (tube) should be included in the assembly, capable of being fitted over the frangible bolt to protect adjoining parts of the helicopter from shrapnel damage if the bolt is fractured by explosion. The tube can be constructed of CRES tubing, 1" OD X 1-3/16" L with a 3/8" hole in the capped end for fitting over the down-stream clevis bolt onto which the frangible stud is threaded. The other end of the tube will ~~two-block~~ onto the large jamb nut which locks the frangible stud into the tension link firing assembly. This device was made and tested on 9 December during the full lead, electrical firing and

manual release trials. When the frangible bolt was fractured by firing the charge contained therein, the bolt fractured cleanly, the shrapnel was contained within the tube, and the only apparent result was a bell-ing of the open end of the tube. Figure 2 (attached) shows this deformation. The bell-ed tube accompanies this report.

7.2.2 To insure positive contact of the explosive charge in the frangible stud, the instructions should be amplified to include the following, or words to this effect.

"To properly seat the frangible stud into the tension link body, disassemble the large jamb nut from the frangible stud. Thread the stud by hand into the tension link body with sufficient force to compress the spring loaded contact in the body and thusly to insure good electrical contact. Next, assemble the jamb nut onto the frangible nut and set it up hard against the tension link body to insure that the stud will be held in position. Slip the protective tube over the stud. By turning the weak-link clevis, insert the clevis bolt into the stud and lock the bolt with the small jamb nut...."

C. F. Scharfenstein

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Encl: (1) Photographs
(2) Protective Tube

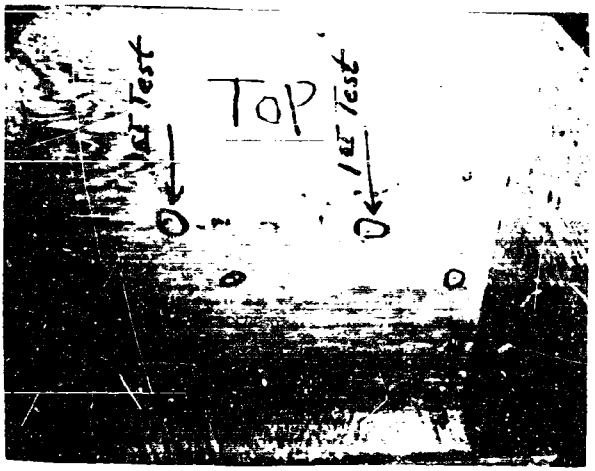

Figure 1
Shrapnel Impact Points

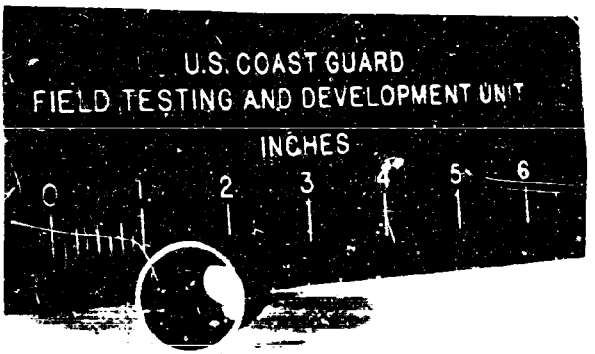

Figure 2
Protective Sleeve

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